

THURSDAY, OCTOBER 22, 1914.

EXPERIMENTAL AND PHILOSOPHICAL BIOLOGY.

- (1) *Experimental Zoologie*. By Dr. Hans Przibram. 4. Vitalität. (Lebenszustand.) Pp. viii + 179 + x plates. (Leipzig and Wien: Franz Deuticke, 1913.) Price 10 m.
- (2) *Mechanism, Life and Personality*. An Examination of the Mechanistic Theory of Life and Mind. By Dr. J. S. Haldane. Pp. vii + 139. (London: John Murray, 1913.) Price 2s. 6d. net.

(1) FROM the point of view of an experimental zoologist, Dr. Przibram has made a very valuable study of the distinctive characters of organisms, which may be ranked in three groups—structural, chemical, and functional. Organisms have a heterogeneous structure, showing at least cytoplasm and nucleoplasm, and they develop by self-differentiation. Organisms also show chemical differentiation, being built up of heterogeneous proteids in a colloidal state. Organisms grow in an active way; they utilise food different from themselves; they multiply in a manner certainly different from the division of crystals; they often show apparently spontaneous movements; and they have an unusual power of preserving impressions of previous states. It is interesting to notice how little agreement there is as yet among biologists as to the best way of stating these general characters of organisms. Przibram's is marked by a desire to avoid any exaggeration of the apartness of living creatures or any discouraging of the methods of mechanistic interpretation.

It is experimentally possible to mimic, with inorganic materials, the growth, movements, and even division of simple organisms, and a bowl of gelatine may illustrate the power of retaining traces of previous influences after the original conditions have been restored. Many beautiful experiments point to the conclusion that the geometrical forms displayed by many organisms, e.g. in their shells and skeletal parts, are expressions of the properties of the "aggregation-state" of the protoplasm. The polarity, likewise, of an organism admits of interpretation in terms of the "layering" or zonal distribution of different kinds of substances, and in similar ways.

The rapid advances of synthetic chemistry (only possible, however, through the directing intelligence of the chemist), show that we must not make too much of the chemical complexity of the proteids so characteristic of organisms; the difficulty as to the optically active nature of vital organic substances may be overcome; and the fact

that fermentation- and oxidation-processes are slower when the living vehicles, e.g. yeast and red blood corpuscles, are absent, may be due to the greater concentration afforded by the organisation of the living cells. Living implies action and reaction between the organism and its environment; the continuance of the creature's activity depends on its structural organisation and on its specific series of chemical processes; violent death ensues when changes in the complex environment (chemical reagents, humidity, concentration, pressures, gravity, electricity, radiant energies, and temperature) fatally disturb the chemical processes, or break down the structure, or prevent the persistence of the organisation by disarranging the chemical routine.

Przibram has made many observations on the rate of growth in different types, and his general result takes us back to Herbert Spencer. A doubling of the mass of the living cell leads to the break-down of that cell, and the process is comparable to the "autokatalysis" observed in some non-vital chemical transformations. Surely in its movements, at least, the animal is spontaneous and unique. But the author bids us consider all the taxisms and tropisms—the inevitable responses which the creature makes in response to external stimuli—of light, heat, pressure, humidity and so on. He seems to us to lay on the shoulders of taxisms and tropisms a burden heavier than they can bear, and we do not think that what Jennings observed of an amoeba on the hunt can be fully redescribed along these lines. It is plain, however, that the interpretation in terms of taxisms and tropisms must continue to be worked for all it is worth until we get quite below the stage of opinions. In answer to the common criticism that we see different answers given by the same or similar organisms to precisely similar stimuli, Przibram admits that we must take account of the physiological condition of the organism as affected by previous experiences, both personal and racial. This is a crucial point—whether inorganic bodies can be said to have "duration" in Bergson's sense—the power of continuing the past into the present. Przibram admits that living creatures have the power of registering the past in a notably high degree, but he declines to credit them with the exclusive possession of this quality, recalling for instance the facility with which a piece of steel is magnetised after it has been magnetised before.

As regards transformations of energy, organisms are marvellous engines, but they conform to the laws of thermodynamics. The conclusion arrived at is that we cannot assert that there operates in organisms any form of energy which is not

known in the inorganic domain. Of course, we have our psychical life, but can we say that this makes a thoroughgoing distinction between organisms and inanimate bodies? How can we tell? Thus there ends a masterly book—scholarly, keenly critical, and rigidly objective. We do not think that the author shows the sufficiency of chemico-physical formulæ for the description of the phenomena of life, but we have the strongest admiration for his searching criticism of the doctrine of the autonomy of the organism. His book should be read along with Johnstone's "Philosophy of Biology."

(2) "The time is now more than ripe," Dr. Haldane writes, "for bringing the great biological movement of the nineteenth century into definite relation with the main stream of human thought," and his lectures form an important contribution towards the fulfilment of this task. The first lecture contrasts the mechanistic and the vitalistic interpretations. The former is certainly good so far as it goes, for the living creature can be usefully considered as a very complex material system, conforming to the laws of dynamics, exhibiting physical and chemical processes that are in line with those of the inorganic world, and as for consciousness (if that be demonstrable) it makes no difference to the energy balance whether the organism is conscious or not. It is true that the activities of the organism are very wonderfully co-ordinated towards securing the survival of the individual and the race, but it is replied that there are effective nervous and chemical means which secure this co-ordination, and have been wrought out in the course of untold ages of variation and selection. It has to be admitted, however, that what goes on is more complicated than the working of any machine known to man; that mechanical interpretations of such functions as excretion and respiration have had to be abandoned from time to time because they did not cover the facts; that heredity, variation, and development seem facts *per se*; and that the organism is strangely autonomous. For these and similar reasons there is periodic reaction from mechanism to vitalism.

"Vitalism assumes that the intimate processes are guided or controlled by an influence which is manifested only in living organisms, and which acts in a manner wholly different from anything known in the inorganic world."

To Dr. Haldane the theory of vitalism is no more acceptable than that of mechanism. For if a vital principle controls what goes on in the organism, can it do so without a breach in the conservation of energy; and if it guides, how does it know how to do it? The hypothetical vital principle is unproved, unintelligible, and useless.

In this chapter, the answer to Driesch's argument from embryonic development seems to us very far from clear.

The second lecture contains a criticism of the mechanistic theory. It has been useful in stimulating research, but it is inadequate for the re-description of what is essentially vital. A minute increase in the hydrogen ion concentration of the blood induces an intense activity of the respiratory centre, but we do not know the chain of events between the stimulus and the response.

"In the case of stimulus and response there is in reality no experimental evidence whatsoever that the process can be understood as one of physical and chemical causation."

Or what are we to make of the "recovery of functional activity after destruction of centres or nerve paths on which this activity normally depends?" Moreover, the fact is that "physico-chemical explanations of elementary physiological processes are as remote as at any time in the past." Even if we could picture the vast assemblage of delicately-adjusted cell-mechanisms, keeping themselves in working order year after year, keeping in exact co-ordination with all the other cell-mechanisms, and so on, how can we conceive of this condensed into a germ-cell, uniting with another germ-cell, and then developing afresh. And the difficulty of thinking mechanically of reproduction recurs when we picture the continual renewal of cells and plasm within the body, the ceaseless work of maintaining a structural and functional specificity. Dr. Haldane concludes that "the phenomena of life are of such a nature that no physical or chemical explanation of them is remotely conceivable." In speaking of the mechanistic view of the germ-plasm, the author says, p. 58: "On the one hand we have to postulate absolute definiteness of structure, and on the other absolute indefiniteness." But it seems to us that the word indefiniteness is here used in a sense not inconsistent with definiteness, namely, in reference to the number of divisions that may occur. If we understood *one* division, we should not boggle over an indefinite number of them.

In his third lecture Dr. Haldane turns the tables on the mechanists. The physical and chemical concepts are, after all, but working hypotheses; the notion of a real and self-existent material universe does not survive Hume's criticism. In any case, when we pass to the world of organisms we need new concepts, especially that of the living organism, a specific entity, actively maintaining and reproducing its individual structure, with functions which are determined in definite relation to the whole unified

activity, an autonomous active whole. "The conception of organism is a higher and more concrete conception than that of matter and energy." In the ruins of the atomic theory, it is already being extended to the whole of nature. "We are not seeking to reduce the organic to the inorganic, but the inorganic to the organic." To us it appears unnecessarily dogmatic to assert that "there is not the remotest possibility of deriving the organic from the inorganic." Would it not serve to say that we cannot think of the origin of organisms from the inorganic world, if the reality of the latter is supposed to be exhausted by the current concepts of chemistry and physics? And are we not bound in fairness to admit that while the physical and chemical formulæ need not be regarded as exhausting the reality of the inorganic world, they serve for certain practical purposes exceedingly well, and must bear a definite relation to reality since we successfully stake our lives and our reputations (as scientific prophets) on their validity.

The fourth lecture finds a philosophical foothold in the recognition of personality as the central fact in the world. We may consider a man as a material system weighing seventy kilogrammes, and this partial and abstract way of looking at him is sometimes of use; we may also consider him as an organism, maintaining specific structure and activity, and this is also useful; but we get nearest the real man when we know him as a person. Personality—mere organism—matter: "the relation is simply one of different degrees of nearness to reality in the manner in which phenomena are described." But personality is more than an individual concept; "the personality of any individual is the spiritual inheritance of ages; the individual participates in the life of the species; personality includes within itself our whole universe. We know extremely little about what we call matter; "the reality behind the appearance of a physical world has and can have no existence apart from personality." And thus, as the physiologist in his first two lectures sought to lead us away from the error of mechanism, so the philosopher in the last two seeks to lead us to the conclusion that the world, with all that in it is, is a spiritual world. But the realist has also something to say for himself!

FUELS FOR POWER PRODUCTION.

Fuel: Solid, Liquid, and Gaseous. By J. S. S. Brame. Pp. xv+372. (London: Edward Arnold, 1914.) Price 12s. 6d. net.

MR. BRAME'S treatise is one of a long succession of books dealing with the general subject of fuels, but in view of the wonderful

rapidity with which processes relating to fuel manufacture and its preparation are changing, and of the new uses to which the fuels are put when made, there is ample room for new-comers. The author writes specially for the large class of readers to whom power production is of chief importance, and he has produced a volume which will be an extremely valuable addition to their bookshelves.

The subject divides itself naturally into three divisions—solid, liquid, and gaseous; Mr. Brame discusses each separately, and adds a section on fuel analysis, calorimetry, and the control of fuel supply. Under the title "Solid Fuels" are included wood, peat, coal, coke, coalite, and the minor fuels; liquid fuels include petroleum and tar oils with their derivatives, together with alcohol. The longest section, that on gaseous fuels, contains an account of the manufacture and properties of water gas, of Siemens and Dowson gas, and of blast-furnace and coke-oven gases.

Well-informed as the author appears generally to be, he makes a strange omission when discussing the velocity of flame propagation in an explosive mixture—the stranger in a book bearing specially in view the production of power—in that he omits reference to the striking influence on this velocity of "turbulence" in the gaseous mixture. As Clerk has shown in the reports of the Gaseous Explosions Committee, turbulence is of first importance in influencing the velocity with which the explosion spreads to all parts of the gas, and that except for this no high-speed gas or petrol engine would be able to run at the speeds necessary for their effective use.

The Bonecourt system of surface combustion is described briefly, but perhaps as fully as can be expected in a book dealing with fuel itself rather than with its manner of use. The author compares the 90 per cent. efficiency of this system when applied to the heating of steam boilers with the 55 to 65 per cent. which is usual with coke-oven or blast-furnace gases used in the older way. This improved method of steam raising is potentially of great practical importance, and we are glad the author has found space to include a number of interesting efficiency figures.

Under the title "Economic Aspects of Liquid Fuel" the author discusses the present situation in which fuel users are placed owing to the rapid change in price. He reiterates the relative insignificance of the annual oil output compared with the coal output, and affirms his belief in the possibility and the economic advisability of the production of alcohol for power uses. This is one of the best parts of the book, and the author is assuredly correct in saying of industrial alcohol: